2nd Suppl Response

Atty. Docket No. 1501-1170

PATENTS 8-13

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Sergey K. GORDEEV et al. Confirmation No. 8547

Serial No. 09/424,760 GROUP 1754

Filed February 3, 2000 Examiner Stuart Hendrickson

METHOD FOR PRODUCING A POROUS CARBON ARTICLE AND AN ARTICLE PRODUCED THEREBY



**SUPPLEMENTAL RESPONSE**

Commissioner for Patents

Washington, D.C. 20231

Sir:

Supplemental to the amendment filed October 2, 2002 and responsive to the Official Action of December 6, 2002, the following remarks constitute applicants' remarks regarding requested data:

The great advantage of having a calculation formula that predicts the carbon micro porosity expected after chlorinating of a metal carbide is that time and efforts are spared. For simple carbides, like TiC, the advantage over making a synthesis and pore analysis might seem lesser, but the superiority of the formula emerges when predicting the carbon micro porosity of chlorinating a solid solution like $TiC_{1-x}$, $0<x<0.5$, or when looking upon more complex metal carbides like $B_4C$.

It is demonstrated in the table below that by using the commercially available $TiC_{1-x}$ a wide range of structural carbons

with micro porosity from 0.85 nm to 2.0 nm can be obtained. Thus, using the easily chlorinated titanium carbides (temperatures well below 1000° C) predictions may be done of the substoiciometric level to use of the $TiC_{1-x}$ precursor to obtain a certain carbon micro porosity size. The possible porosity range of this precursor is important for most carbons used in atomic and molecular sieves as well as for electrodes of batteries and capacitors.

For practical reasons, those metal carbides might be avoided where the metal chlorides formed by the reaction need extremely high temperatures to volatize and be removed from the reaction zone. At furnace temperatures above 1000° C, and especially at temperatures above 1100° C, the formed nano structural amorphous carbon will, at an accelerating rate, start to partly form graphite. This results in an inconvenient reduction of nano pore volume and available surface and smaller pores are preferably consumed first. A shift of obtained pore sizes towards the higher end results and the calculation formula is less accurate. Unfortunately, chromium is such a metal that forms chlorides that need extreme furnace temperature of 1100° C or higher. However, the experiment was done at 1100° C and the X-ray diffraction showed a clear start of some graphitization and the obtained pore size was, as expected, slightly higher than the calculated values.

| Metal carbide precursor | Molecular weight (g/mol) | Density (g/ccm) | Number of carbons in formula | Calculated pore size (nm) | Obtained pore size (nm) |
|---|---|---|---|---|---|
| TiC | 60 | 4.90 | 1 | 0.82-0.94 | 0.85 |
| $TiC_{0.5}$ | 54 | 4.91 | 0.5 | 1.97-2.27 | 2.0 |
| $B_4C$ | 55 | 2.52 | 1 | 1.95-2.25 | 2.1 |
| $Mo_2C$ | 204 | 9.18 | 1 | 2.00-2.31 | 2.1 |
| $Cr_7C_3$ | 400 | 6.97 | 3 | 1.63-1.88 | 2.3 |

Respectfully submitted,

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